SEAFLOOR INTEGRITY

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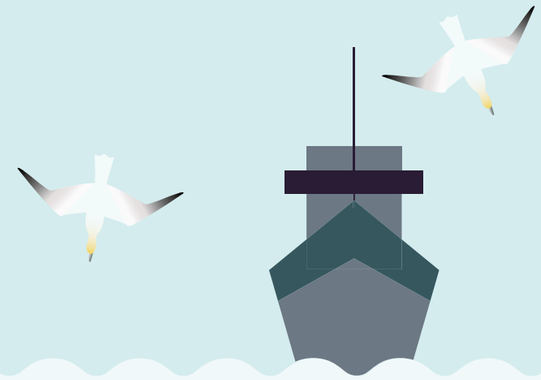
Executive Summary



Fishing with mobile gear is known to affect many characteristics of the seafloor and can destroy or seriously degrade some types of seabed such as maerl and cold water coral beds.

On other seabed types the disturbance caused by mobile gear may be similar to that caused by natural factors such as wave action. A particular problem in determining the level of impact caused by mobile gear is a lack of pre-disturbance data for virtually the entire seabed, and technical and conceptual difficulties in setting appropriate reference conditions in the absence of such data. The Marine Strategy Framework Directive (MSFD) Descriptor Six "Seafloor Integrity" (D6) presents serious challenges because many of the Criteria for its achievement include Indicators which have not been routinely monitored and for which it will be difficult to procure "expert judgements".

Discussion within the EU member states continues about what should be measured, how these measurements should be made and how different measures should be combined to make decisions on the Environmental Status of the North-East Atlantic Region.

As a result it is currently impossible to make judgements on whether Scottish waters are in appropriate conditions to contribute to "Good Environmental Status" (GES), or on the adequacy of measures currently in place. What is possible at this point is to recommend how Scottish Environment LINK (hereafter LINK in this document) could approach the assessment of GES, in particular with respect to D6. This includes recommendations on how reference conditions for D6 could be established and what evidence is required to demonstrate appropriate levels of the D6 Indicators.

A key principle underpinning our work here is that "Sustainable Use" of the sea is permitted under MSFD and that for D6 the Indicator levels do not have to be at "reference level" (or even close to it) for this standard to be achieved.

What must be demonstrated is that the seafloor and its associated characteristics and species have the ability to "rapidly" recover to an appropriate reference level.

The current and proposed Nature Conservation Marine Protected Areas (NC MPAs) provide an important test of the current resilience of benthic systems. Unless they demonstrate rapid recovery of the seabed to predicted reference levels it will not be possible to say that the wider seas are being used sustainably. We recognise that the NC MPAs have not been designed for this purpose and are often not typical of the surrounding seafloor. Fortunately the Demonstration and Research MPA (D&R MPA) mechanism exists to conduct time-limited investigations ideal for this purpose.

If MPAs do not demonstrate recovery this would be evidence of unsustainable use of the wider sea area and would require further measures.

This could include larger protected areas or greater restrictions on fishing pressure or gear types. If the NC MPAs are to contribute to our understanding of sustainable use it is very important that monitoring begin immediately and at sufficient temporal resolution to allow change to be assessed. Given the cost implications it is essential that a small number of proxies for wider change be identified. We have concerns about the logic of using measures of pressure such as Vessel Monitoring System (VMS) data to assess D6 criteria as these can, at best, indicate current state and will seldom be able to predict whether the use is sustainable for factors relevant to D6.

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“Good Environmental Status” requires that marine systems are in ‘natural’ condition, or at least that their current management is ‘sustainable’ by 2020.

Under Rice et al.’s (2010) interpretation of MSFD sustainable management should be such that removal of the pressures would “rapidly” allow the system to return to a natural state.

Introduction

European marine species and habitats are under continuing pressure from human activities (European Environment Agency 2015).

There is still significant uncertainty regarding what will be required in order to achieve ‘Good Environment Status’

The Marine Strategy Framework Directive (2008/56/EC) was developed from a recognition that the environmental impacts of some activities (e.g. fishing, shipping) need to be managed across national boundaries. The aim of the MSFD is to manage human activities in the EU marine environment and to balance maritime development and resource use with environmental protection. The main goal of the MSFD is to achieve “Good Environmental Status” (GES) of EU marine waters by 2020 (European Commission 2008). Member States are required to develop Marine Strategies for their waters including: an initial assessment of their marine waters; characteristics, targets and indicators of GES; monitoring programmes for measuring progress towards GES, and; programmes of measures to achieve or maintain GES.

Achievement of “Good Environmental Status” (GES) under the Marine Strategy Framework Directive (MSFD) requires that marine systems are in “natural” condition, or at least that their current management is “sustainable” by 2020. Under Rice et al.’s (2010) interpretation of MSFD sustainable management should be such that removal of the pressures would “rapidly” allow the system to return to a natural state. Any effort to demonstrate GES therefore requires understanding of the natural state of the relevant descriptor, how close ecosystems are to this state and the relevant pressure-state relationships. There is still significant uncertainty regarding what will be required in order to achieve GES, leading to further uncertainty about whether current measures are adequate to achieve GES or whether additional measures are required.

Descriptor 6, seafloor integrity, is intended to ensure that human pressures on the seabed do not hinder the ecosystem components from retaining their natural diversity, productivity and ecological processes. The seabed and benthic habitats underpin key processes and elements of the marine ecosystem. Human activity can alter the physical characteristics of the seafloor including relief and composition of bottom deposits. The rate and intensity of impact and the seafloor characteristics affect whether changes to the seafloor will have negative consequences for the seafloor biotopes and the general ecosystem condition. The physical damage to the seafloor from human activities must account for characteristics of bottom sediments (substratum), particularly where physical changes to the seafloor have direct impacts on bottom biotopes. There are a number of other activities that result in physical damage of the seabed through abrasion, however, the spatial extent of damage from bottom fisheries is considered to far outweigh the contribution of other sources of this pressure (Defra 2012).

Definitions and Concepts

MSFD

The aim of the European Union's Marine Strategy Framework Directive (MSFD) (European Commission 2008) is to protect more effectively the marine environment across Europe. It is the first EU legislative instrument related to the protection of marine biodiversity as a whole including ecosystem functioning, as it contains the explicit regulatory objective that "biodiversity is maintained by 2020", as the cornerstone for achieving GES.

The Directive enshrines in a legislative framework the ecosystem approach to the management of human activities having an impact on the marine environment, integrating the concepts of environmental protection and sustainable use. The aims of the Directive are to:

'Protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected;'

'Prevent and reduce inputs in the marine environment, with a view to phasing out pollution, so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea.' MSFD 2008/56/EC Article 1(2)

An ecosystem based management approach to the management of human activities must be applied by member states. This means that cumulative pressure of human activities is compatible with the achievement of GES ensuring that the marine environment has the capacity to respond to human-induced changes and enables the sustainable use of the marine environment now and does not preclude future sustainable use. MSFD 2008/56/EC Article 1(3).

GOOD ENVIRONMENTAL STATUS (GES)

The environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are intrinsically clean, healthy and productive, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations." MSFD 2008/56/EC Article 3. GES is defined according to 11 "Descriptors" covering a wide range of overlapping attributes of marine systems and human impacts.

No.	Descriptor
1	**Biological diversity maintained**
2	**Non-indigenous species**
3	**Commercial fish & shellfish**
4	**Food-webs**
5	**Eutrophication**
6	**Sea-floor integrity**
7	**Hydrography**
8	**Contaminants**
9	**Contaminants in seafood**
10	**Litter**
11	**Energy, incl. underwater noise**

Table 1. MSFD ANNEX I Qualitative descriptors for determining good environmental status

Member states are required to have their own definitions of GES following each member states' initial assessment. The ecological concept behind the MSFD consists of comparing the current state of an area with that which would be expected under minimal or sustainable use or if degraded, intervention to restore the area to GES (Mee et al. 2008, Van Hoey et al. 2010).

The UK characteristics of GES and associated targets and indicators have been developed for the UK marine waters as a whole (Dupont et al. 2014). The characteristics of GES have been developed by policy makers in consultation with experts and key stakeholders to provide a high level, qualitative description of the UK marine environment in GES (Defra 2012). The UK targets and indicators of GES have been developed on the basis of scientific advice from CEFAS, JNCC and others (Defra 2012). The targets and indicators are more specific and where possible quantitative, and informed by the Initial Assessment.

JNCC and experts in the Healthy and Biologically Diverse Seas Evidence Group led the development of advice on targets and indicators for Descriptors 1 (biodiversity), Descriptor 4 (food webs) and Descriptor 6 (seafloor integrity). The three descriptors have significant overlap and therefore the selection of key groups of species (fish, birds and mammals) and habitats (sediment habitats, rock & biogenic reef habitats and pelagic habitats) allowed for the same targets across descriptors to minimise duplication.

For proposed GES targets for species (fish, birds and mammals), existing targets (e.g. Habitats Directive, OSPAR) have been used where suitable, utilising existing indicators and monitoring programmes. For seafloor habitats existing targets under the Habitats Directive and Water Framework Directive (WFD) have been used where possible. As the UK Government reportedly considers the SAC network to be "substantially completed" they appear to assume that measures taken under the Habitats Directive will be sufficient to achieve the target for designated seabed features. New targets have been developed for broad scale sediment habitats not covered by the Habitats Directive and MPAs are expected to be a key measure, but additional management measures may be needed (particularly in relation to fisheries impacts) (Defra 2012).

SEAFLOOR INTEGRITY

Like all MSFD descriptors, seafloor integrity has a brief definition within the Directive, but this has been followed by various attempts to interpret the description and develop operational definitions.

Descriptor 6: Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystem are safeguarded and benthic ecosystems, in particular, are not affected.

- ***Sea Floor*** – physical and chemical parameters of seabed – bathymetry, roughness (rugosity), substrate type, oxygen supply etc; and biotic composition of the benthic community.
- ***Integrity*** – spatial connectedness, habitats are not unnaturally fragmented, characteristic natural ecosystem processes functioning. Areas of high integrity on both of these standards are resilient to perturbations, **human activities can cause some degree of perturbation without widespread and lasting harms to the ecosystems.**
- ***Structure and functions of ecosystems*** – commonly used concept in ecology, concept is used in its conventional sense.
- ***Not adversely affected*** – **impacts may be occurring**, but all **impacts are sustainable** such that natural levels of diversity, productivity, and ecosystem processes are not degraded. (Rice et al. 2010).

The description of the seafloor provided by Rice et al (2010) sounds like a practically pristine marine environment and some aspects appear to be contradictory. For instance at one point the requirement is only that harm should not be "lasting", implying that harm, presumably change from a natural state, is permitted if temporary. Later it refers to impacts being "sustainable", which again implies that the key issue is the future potential of the system. But at points the Descriptor appears to indicate that the seafloor is supposed to approximate a natural state in order to meet its requirements.

This is clearly not possible at even very low levels of exploitation. As a result our report focuses on the concept of sustainable use and how this can be assessed for D6.

The GES definition for D6 is considered inadequate; not specific enough and is only set at the descriptor level (Dupont et al. 2014). Additionally, the D6 definition is highly variable between member states (Cavallo et al. 2016) such as shipping and fishing. The European Marine Strategy Framework Directive (MSFD). The UK characteristics of GES for Descriptor 6 were outlined in the UK initial assessment:

"Sea-floor habitats (physically and structurally) are both productive and sufficiently extensive at the level of the MSFD sub-regions, to carry out natural functionality, including the necessary ecological processes (e.g. cycling of carbon and nutrients) which underpin ecosystem goods and services (e.g. food security and climate regulation), and are capable of supporting a healthy and sustainable ecosystem for the long term."

In order to turn these definitions into something which can be used operationally there needs to be some clarity about what should be measured and what would constitute success. While this could result in detailed targets for literally dozens of taxa and geological or geochemical traits we suggest that the key metrics can be reduced to the following two categories.

RECOVERY

Under management 'the impacted seafloor attributes show a clear trend towards their pre-perturbation conditions, and the trend is expected to continue (if pressures continue to be managed) until the attributes lie within their range of historical natural variation. Benthic communities are not static entities, and thus recovery does not require that the ecosystem attributes return to their exact prior state.' (ICES 2014a).

RAPID

'must be interpreted in the context of the life histories of the species and natural rates of change in the community properties being perturbed. For some seafloor habitats and communities, recovery dynamics from perturbation would require multiple decades or more, and in such cases management should strive to prevent perturbations.' (ICES 2014a).

The required pace of change represents an extremely contentious issue. Some authors suggest that rates of recovery should be linked to the life history characteristics of the species or seabed type under consideration. For some purposes this makes sense, for instance an MPA should not be considered to have failed if a *Lophelia pertusa* reef has not regrown within a few years of its former location being protected. For the purposes of assessing GES though **we believe that rapid should mean the common sense definition and that recovery which takes decades cannot meet this standard**. Seabed types which do not show recovery within a decade of protection cannot contribute to GES. Depending on the aggregation rules used this will require higher standards elsewhere in order to balance out the deficit. The only way to avoid reductions in MSFD scores is to completely avoid damage to any seabed type which cannot recover rapidly from impacts.

A key example of the Recovery and Rapidity concepts is the deep sea. The magnitude of change in deep sea fish population density from fishing was not particularly large for some species, suggesting drops in biomass similar to those expected to provide MSY in shallow-living species. Therefore the issue with deep sea fish assemblages wasn't how far they were from known reference conditions, but how quickly the change had happened and how long recovery would be expected to take (Bailey et al 2009). The seriousness of a perturbation relates both to its magnitude and its longer term consequences. If the definition of "rapid" is allowed to vary then impacts to low-productivity environments such as the deep sea, which take decades to repair, could be considered no more serious than impacts to a dynamic and naturally shallow environment which recovered in a year.

CRITERIA AND INDICATORS

Table 2. Criteria and indicators for Descriptor 6: Seafloor Integrity.

6. Sea-floor intergrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adersely affected.	
6.1. Physical damage, having regard to substrate characteristics	**6.2. Condition of benthic community**
6.1.1. Type, abundance, biomass and areal extent of relevant biogenic substrate **6.1.2.** Extent of the seabed significantly affected by human activities for the different substrate types	**6.2.1.** Presence of particularly sensitive and /or tolerant species **6.2.2.** Multi-metric indices assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species **6.2.3.** Proportion of biomass or number of individuals in the macrobenthos above some specified length/size **6.2.4.** Parameters describing the characteristics (shape, slope and intercept) of the size spectrum of the benthic community

The Initial Assessment identified significant problems in the development of GES targets for a number of seafloor habitats, particularly shallow and shelf subtidal sediments. The targets and indicators were developed for habitat distribution, habitat extent and habitat condition, as well as physical damage (to the seabed) and the condition of the benthic community.

Detailed indicators are available in Annex 1 of the UK Initial Assessment (Defra 2012). The Indicators are a combination of pressure and state indicators, yet it is a highlighted problem that we do not have detailed information for the state of seafloor habitats only limited information regarding the extent of pressures.

A key knowledge gap highlighted in the UK report was the need to develop detailed baseline information for assessing the quality/condition of benthic habitats as well as habitats resilience towards pressures exerted upon them (thresholds for loss and damage). A particular challenge in assessing GES of the seafloor is delineating appropriate scales (Rice et al. 2010).

ICES (2015) considered replacing one or more of the criteria with a new criterion of "Recoverability", a position which appears to be a logical response to the Descriptor. There was a great deal of resistance to this from member states, mainly on the basis that this was even harder to assess than direct measures of state. Our view is that there is no need to change the Criteria, but measures of recoverability will provide the most powerful evidence for any of the criteria under MSFD when seeking to test sustainable use.

What is the condition of the Scottish seafloor compared to a pre-trawling baseline?

The establishment of environmental baselines and targets enabling the regular evaluation of the state of the marine environment is an essential step towards achieving GES (Hill et al. 2012).

The baseline against which GES should be assessed under the MSFD is the 'reference condition':

"a state at which impacts from anthropogenic pressures are negligible" (OSPAR Commission 2011).

Robust targets for achieving GES can be set in an ecologically meaningful manner when set against this reference condition as they do not adopt an already degraded environmental state as an acceptable baseline (Hill et al. 2012).

These are very challenging requirements. Finding marine habitats in reference condition in the North-East Atlantic is rare; human activity has been widespread and long term, having had an impact on most marine ecosystems (Hill et al. 2012). Baseline data is lacking for many parameters and so descriptions of natural conditions or levels of function must be justified in other ways. The question of sustainable levels of use is just as difficult to answer. There will need to be an understanding that the form of the pressure-state relationship may be different as pressure is reduced than it was when pressure was increased.

Recovery to a previous baseline may be impossible because of the degree of modification to the ecosystem, or because the prevailing climate has changed. Additionally, no methodology has been determined for determining thresholds for sustainable functioning ecosystems in GES and no single GES threshold for any indicator will be appropriate across a whole region (Van Hoey et al. 2010).

For some descriptors there are relatively clear criteria and even if baseline data do not exist there are long time series. A good example of a data-rich descriptor would be Descriptor 3 on the health of commercial fish species populations. Other descriptors involve attributes and functions which have not been routinely measured and therefore present more difficulties. The single descriptor "seafloor integrity" includes a wide range of physical and biological features, many of which are highly susceptible to human impacts. These include the type and three-dimensional arrangement of sediments, benthic biodiversity and ecosystem functions. The descriptor therefore includes parameters which are seldom measured, let alone the subject of long time series with good pre-disturbance baselines.

The UK technical assessment of MSFD (Dupont et al. 2014) highlighted that for seafloor habitats there are gaps in our knowledge of the features affected and their geographical occurrence. The report also stated that available evidence for physical damage to the seafloor, suggesting the effects of bottom fishing gear are much more extensive than reported, does not appear to have been used. Additional gaps in the knowledge on the distribution of human activities and pressures across the sub region, and the quantification of intensity and extent of pressures also exist; plans to address these gaps have been made (Dupont et al. 2014).

A number of approaches can be taken towards establishing a baseline or reference condition, first amongst these is the use of existing reference areas. These reference areas are only relevant to MSFD if a habitat shows minimal or no ecological effects resulting from anthropogenic activities (Hill et al. 2012). Hill et al. (2012) uses the example of bivalve subsistence collecting, which can continue at a level that does not have significant impacts on the ecological functioning of the habitat, suggesting that this habitat could act as a reference site even in the presence of sustained use as the impacts are negligible.

Inferences can be drawn from areas that have been removed from fishing pressure for long periods (e.g. the Loch Long submarine exercise area).

Hindcasting or statistical and predictive modelling is another method, which has had wide application for setting reference conditions for the marine environment (Hill et al. 2012). Alternative modelling approaches, including: palaeoreconstruction, ecosystem reconstruction and habitat suitability modelling may be useful in the establishment of baseline conditions in benthic habitats (Hill et al. 2012). Existing predictive models of seafloor type around Scotland are known to be incorrect when tested against field data, including in the contentious South Arran NC MPA (Elliott, 2016), which makes using them as the basis for legal decisions on fishing highly concerning. Decisions about the sustainability of fishing would need to be made based on the comparison of field measurements with these model predictions.

Hill et al (2012) concluded that in the absence of baseline data, or even the datasets necessary for modelling a baseline, expert opinion would be the most practicable approach to identifying reference conditions. Here Hill et al (2012) focus on the biodiversity indicators in general (including D6), but do not specifically address the extent to which expert judgement can set reference conditions for ecosystem processes and the physical structure of the seafloor. Compared to benthic biodiversity assessments, which are carried out routinely and for which much experience exists from which judgements can be drawn.

Hill et al (2012) were relatively negative about the use of models to predict baselines, scoring these approaches below expert judgement, undamaged sites and historical reconstructions. For seafloor integrity though, it seems unlikely that historical data or expert judgement will be very effective. While Hill et al (2012) present a framework to formalise the collection and analysis of expert judgements it seems likely that the results of such analyses will be subject to challenge by unhappy stakeholders.

Finding marine habitats in reference condition in the North-East Atlantic is rare; human activity has been widespread and long term, having had an impact on most marine ecosystems (Hill et al. 2012).

Once the indicators for D6 are known, we suggest that targeted data collection for these indicators will be necessary across known gradients of fishing intensity, alongside the measurement of a small set of explanatory variables (depth, wave fetch, seabed type). These measurements will allow hindcasting to reference conditions. This approach has been used by Clarke et al (in prep) to assess the pre-disturbance state of burrowed mud in the Small Isles MPA, showing differences in community composition across a gradient of high to low trawling intensity (over the preceding four years). From this a quantitative target for the newly-closed areas can be chosen. **It will be important to choose simple, cheap indicators and most likely the use of biodiversity and indicator species as proxies for several Descriptors including D6.**

It is important to recognise that determining reference conditions is only informative where efforts are being made to return areas to this condition. It is not necessary to compare areas under use to their reference state. Similarity to reference state is not a criterion for sustainable use, except where it can be demonstrated that the area is at this state despite any uses.

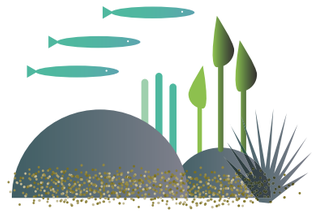
Current management regimes have been criticised for being fragmented and uncoordinated, neglecting the cumulative effects of multiple marine activities and stressors (Markus et al. 2015). Strategic management and planning across sectors is recommended to address regional and long distance effects as well as impacts on their coastlines (Markus et al. 2015). Methodologies for assessing cumulative or synergistic effects of human pressures are the subject of ongoing research.

The UK Initial Assessment (DEFRA 2012) fulfilling its requirement under the MSFD, provided an analysis of the essential features and characteristics and current environmental status of the UK marine environment. Under Descriptors 1, 4 and 6, impacts on seabed habitats were found to be widespread and the composition of seabed habitats altered over large areas. Sediment habitats were more extensively degraded than rocky habitats; subtidal inshore habitats are generally impacted by a greater variety of human activities than offshore habitats and the Southern North Sea, Western Channel/Celtic Sea and Irish Sea are the UK areas impacted by the greatest number of human activities and associated pressures. The distribution of pressures may have changed, however, for most activities the intensity of pressures has been relatively stable over the past decade. The assessment of seabed habitats was largely based on data combined with expert judgement, considering the relationship between habitats and pressures.

It is not necessary to compare areas under use to their reference state. Similarity to reference state is not a criterion for sustainable use.

Is the condition of the seabed consistent with the requirements of EU Directives?

An assessment of the impact of fishing on GES is not currently possible for D6 Seafloor Integrity. There are several barriers to a full assessment at this stage.



Distance from reference state is not a measure of sustainability unless there is zero difference.

Firstly, fishing activity is a pressure indicator, not a state indicator and therefore does not directly provide information on the status of environmental processes. A clear link needs to be made between pressure (mobile bottom gears) and seafloor functioning to enable a pressure indicator to inform on status. In terms of reporting of predicting how close an area is to its reference state, this approach has merit, but as noted above, distance from reference state is not a measure of sustainability unless there is zero difference.

While numerous studies have investigated the small-scale effects of fishing intensity on seafloor characteristics it remains problematic for the key issue of sustainable use and its requirement that the seafloor be able to demonstrate the ability to recover towards a natural state.

In order to demonstrate that fishing pressure can predict sustainable use of the seafloor the following would need to take place:

1. Monitor recovery of areas taken out of mobile gear fishing
2. Correlate rates of recovery with previous levels of fishing at the sites and in the surrounding areas prior to closure.
3. If a relationship is found this might be used to predict the ability of other areas to recover based on the historic fishing intensity in and around them.

Examination of data from VMS (Fig 2) or from interview-based projects such as Scotmap (Fig 3) point to a patchy distribution of fishing, with great variability in intensity for different gears. Large areas are not exposed to mobile gear fishing by >15 m vessels and are too far offshore for mobile-gear fishing by smaller vessels to be intense. Inshore the picture is not so clear, with ScotMap in particular coming under a great deal of criticism for poor coverage of the fishing fleet. As a result our knowledge of pressures and therefore best guesses about current and past seafloor integrity are going to be badly weakened.

Impacts of deep water demersal fishing have been reviewed in other studies (Hinz et al. 2009, Kaiser et al. 2015) the consequences from long-term chronic disturbances are less well understood.

The response of benthic macrofauna to chronic otter-trawl disturbance from a *Nephrops norvegicus* (Norway lobster) fishery includes widespread mortality of benthos, stirring and resuspension of sediments, changes in oxygen penetration depths and sediment geochemistry and destruction of benthic habitats (Martin et al. 2014).

There is a growing understanding that deep bottom trawling can stir and erode the seafloor, altering physical properties and affecting seafloor integrity over large spatial scales. In deep habitats, natural processes may not be able to counterbalance these anthropogenic impacts (Martin et al. 2014).

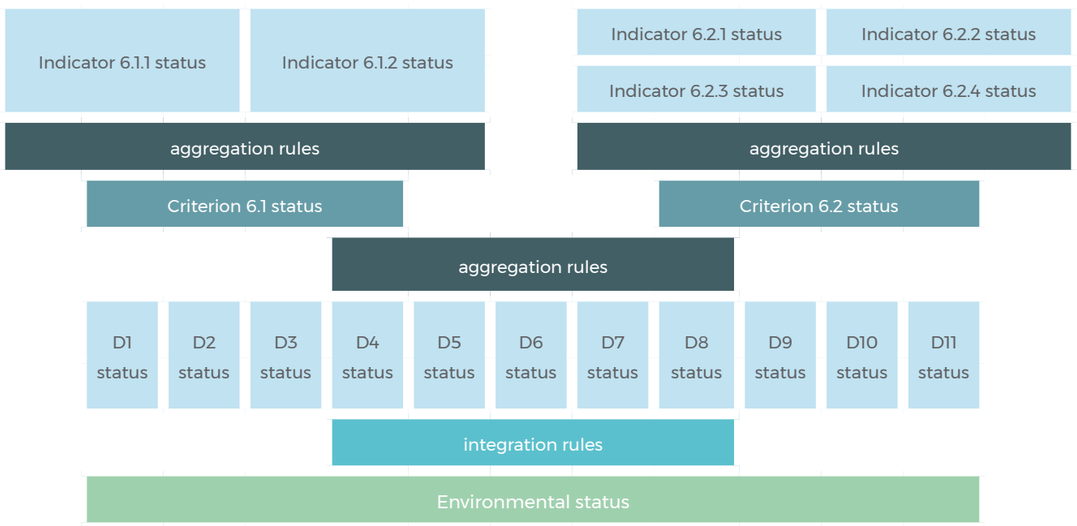
One issue causing major problems is how different indicators, criteria and descriptors can be aggregated together to make a single judgement on GES across whole regions. What proportion of indicators need to pass before a criterion is met, and how many criteria for the Descriptor to pass?

Will Descriptors be aggregated together or be reported separately? For example, does GES require all descriptors to be in GES or is it sufficient for GES to achieve for the majority of descriptors? There is no specific guidance within the MSFD; with the initial assumption that GES is required for all descriptors. Borja et al. (2014) present several methods for aggregating indicators and integrating descriptors to result in a final assessment of GES at a regional scale (Fig 4). These aggregation rules are societal judgements rather than scientific decisions. For example, do we care equally about commercial fish stocks and underwater noise, or is one more important than the other?

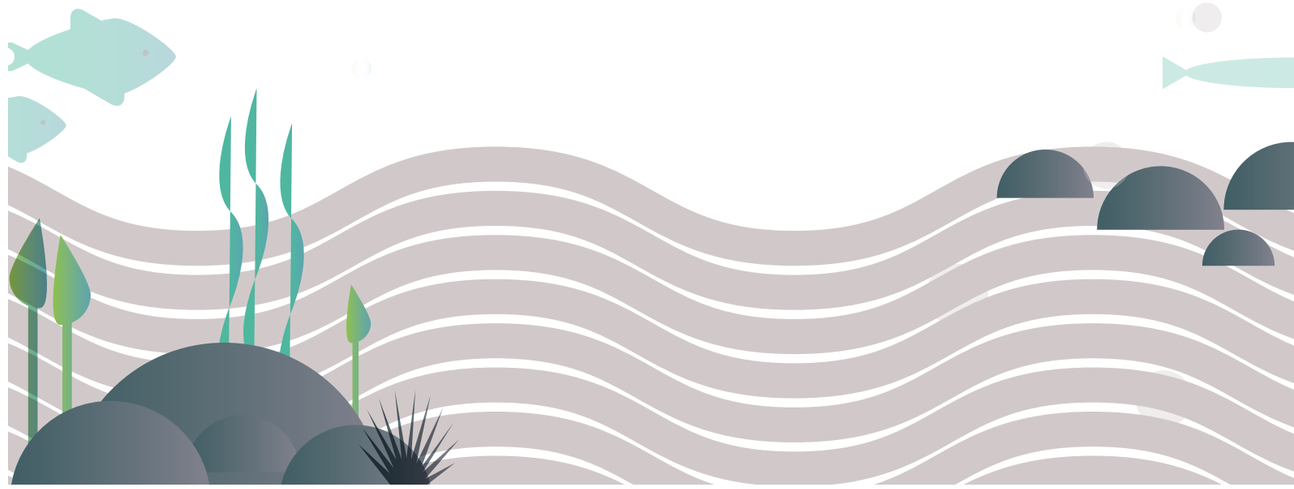
Seafloor attributes, pressures and impacts are patchy on many scales, therefore the indicators and reference levels will differ on all but local scales and monitoring must be adapted to local conditions and expanded for the seafloor (area and type of attribute measured) (ICES, 2010).

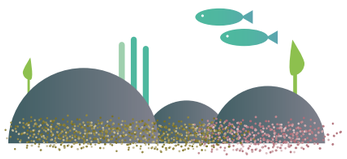
One issue causing major problems is how different indicators, criteria and descriptors can be aggregated together to make a single judgement on GES across whole regions.

Figure 4, Schematic diagram of aggregation from Indicator to GES under MSFD, (From Borja et al. 2014)



Recovery is central to MSFD because most areas of seafloor are under some kind of use and their current state is likely to reflect these uses.





For some seafloor habitats and communities, recovery from perturbation would require multiple decades or more.

No single algorithm to combine indicator values will be appropriate for evaluating GES or provide a meaningful index of GES for seafloor integrity. Expert assessments will likely rather be needed for the evaluation of GES of seafloor integrity (ICES, 2010). Whilst further clarification on how to combine individual GES descriptors into a unified assessment is needed, the Le Quesne et al. (2010) report found that irrespective of whether GES is based on an 'average' of descriptors or that GES needs to be achieved across the board, the current assessment in the North West Waters Regional Advisory Council (NWW RAC) region indicates fishing negatively impacts GES.

Recovery is central to MSFD because most areas of seafloor are under some kind of use and their current state is likely to reflect these uses. Being different from their natural or reference state does not mean that they cannot meet MSFD criteria and contribute to GES. **The key issue is that the seabed needs to be able to revert to a condition that does not prevent future uses of the system.**

The best demonstration of this potential is that when given the chance the system is able to recover back to a natural state, allowing maximum potential to change its use if required in the future. This is the literal definition of sustainability. Recovery does not necessarily require that the ecosystem attributes return to exactly their status before any human use began, because natural variation would have led to changes in them in any case. However, attributes must show a clear trend towards their pre-perturbation conditions, and the trend is expected to continue (if pressures continue to be managed) until the attributes lie within their range of historical natural variation.

Rapid is typically interpreted in the context of the life histories of the species and natural rates of change in the community properties being perturbed. For some seafloor habitats and communities, recovery from perturbation would require multiple decades or more.

It is a societal judgement whether a very slow but measurable recovery can be considered rapid, taking into account the very slow maximum possible recovery rates of some taxa. There are two opposing points of view on this issue. If a reef composed of coral species with a maximum growth rate of 10 mm year^{-1} has been removed by fishing would a growth rate after protection of 9 mm year^{-1} constitute evidence of rapid recovery, even if full restoration of the original habitat would take hundreds of years at such a rate? **The alternative view is that "rapid" has a common sense definition which is not movable and could be set at a fixed number of years.**

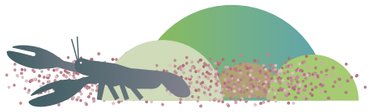
It is probably impossible to assess recoverability for the full range of indicator types under D6 and so measurement will need to be prioritised and use existing datasets wherever possible. In particular proxies for environmental quality such as biodiversity indices, biomass/size frequency distributions and the presence of indicator species are likely to be the most feasible indicators for D6.

There is a large literature linking seafloor biodiversity to ecosystem functions (Zeppilli et al. 2016) and it makes sense to take advantage of this work rather than requiring monitoring of these functions directly.

There are a few properties of the sea floor where only very small levels of impact would be considered sustainable, and the goal of management should always be to prevent impacts on those properties. These properties are ones that are considered to serve important ecosystem functions, such as providing shelter or oxygenating sediments, are fragile and hence likely to be damaged by many pressures (particularly physical disturbance), and have either no capacity to recover or very long recovery times. *Lophelia* reefs and other cold-water coral deposits are examples of such features (Huvenne et al. 2016).

The general trend in legislation with regard to benthic habitats is to focus on rare and vulnerable habitats. Widespread habitats are usually little covered in legislation, yet cover a large area and these widespread habitats may make the largest contribution to seafloor functions. Maintaining ecosystem processes is important to support wider marine ecosystem functioning. GES D6 refers to structure and function of key benthic processes whereas rare and threatened habitats fall under the remit of GES D1 (biodiversity).

Rare/threatened/declining habitats are covered by a range of protected area instruments (e.g. Natura 2000 sites, Sites of Special Scientific Interest, and Ramsar sites). Seafloor integrity must be achieved for widespread or moderately resilient habitats, not just sensitive, rare habitats (ICES 2014a).



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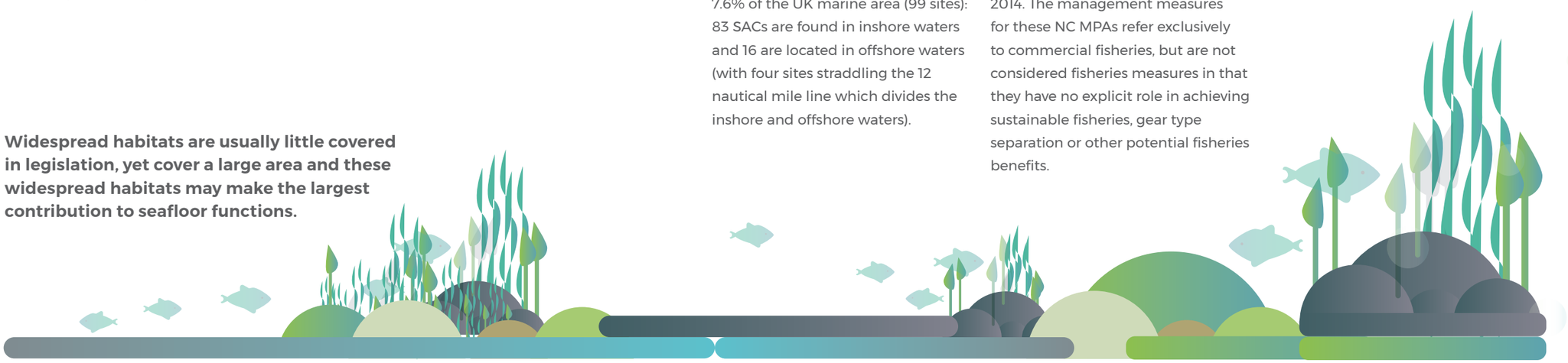


What measures are in place or planned to improve the state of the seafloor?

The UK MPA network is intended to play a key role in supporting the achievement of a number of the UK GES characteristics and targets, particularly for D1 and D6 (UK Initial report 2012).

The UK MPA network is an integral element in the UK's programme of measures and intends to meet the MSFD requirement to designate a coherent and representative network of MPAs (MSFD, Article 13(4)). The UK had made similar commitments previously under the OSPAR convention and World Summit on Sustainable Development (Hopkins et al 2016).

The UK implementation of the EU's Birds and Habitats Directives provides spatial protection for species and habitats in the marine environment. Special Areas of Conservation (SACs) are designated under the EC Habitats Directive for habitats and species listed in Annex I and II of the Directive. SACs with marine components are sites that contain qualifying marine habitats or species. SACs with marine components cover approximately 7.6% of the UK marine area (99 sites): 83 SACs are found in inshore waters and 16 are located in offshore waters (with four sites straddling the 12 nautical mile line which divides the inshore and offshore waters).

Special Protection Areas (SPAs) with marine components are defined as those sites with qualifying Birds Directive Annex I species or regularly occurring migratory species that are dependent on the marine environment for all or part of their lifecycle, where these species are found in association with intertidal or subtidal habitats. There are currently 102 SPAs with marine components in the UK. Four of these sites are entirely marine SPAs. Work is ongoing to designate further SPAs in the marine environment across the UK, with fifteen proposed sites consulted on during 2016-17.

The English Marine Conservation Zone (MCZ) Project resulted in the designation of 27 new MCZ sites in November 2013 and 23 new sites in January 2016. The Scottish MPA Process resulted in the designation of 30 Nature Conservation MPAs in July 2014. The management measures for these NC MPAs refer exclusively to commercial fisheries, but are not considered fisheries measures in that they have no explicit role in achieving sustainable fisheries, gear type separation or other potential fisheries benefits.

A range of specific fisheries spatial measures are in place including permanent or seasonal closures, most of which are outside the "MPA network". A few areas are closed to all fishing, such as the Lamlash Bay No Take Zone, the Royal Navy/Qinetic test area (BUTEC), and because of radioactive contamination off Dounreay and in Dalgety Bay. Year-round restrictions on mobile gear use for fisheries management purposes are in place for much of the inshore area between Arbroath and Aberdeen, off the Berwickshire coast and in several bays and sea lochs, including Broad Bay, under Sea Fisheries Orders. Seasonal measures such as the Clyde cod spawning area closure off Kintyre are less relevant to D6 being less likely to have beneficial effects for seafloor integrity.

Recent decisions at a European level will have a major bearing on large areas of seafloor within Scottish waters. Trawling will be banned deeper than 800 m in all EU waters of the NE Atlantic and all bottom fishing will be banned in areas of "Vulnerable Marine Ecosystems" deeper than 400 m.

http://ec.europa.eu/newsroom/mare/itemdetail.cfm?item_id=32668

VME status is based on both the likelihood that it will be easily damaged but also on its ability to recover http://www.fao.org/docrep/011/i0816t/i0816t00.htm

The removal of such a large area of seabed from impacts from the most damaging gears is likely to benefit measures of seafloor integrity, but the very slow rate of recovery expected for common VMEs such as seabeds with cold water coral and sponges (Huvenne et al. 2016) means that areas already damaged might not help demonstrate GES. Removal of bottom trawling deeper than 600 m would have secured a wider area of VMEs, whose protection remains dependent on their presence being reported.

Maps are indicative based on primary data.

Figure 1. Existing restrictions on trawl fishing in Scottish waters. Areas in orange are the year-round closures relevant to D6. Most permanent trawl closures also prevent dredging (but not Loch Ryan or parts of Luce Bay).

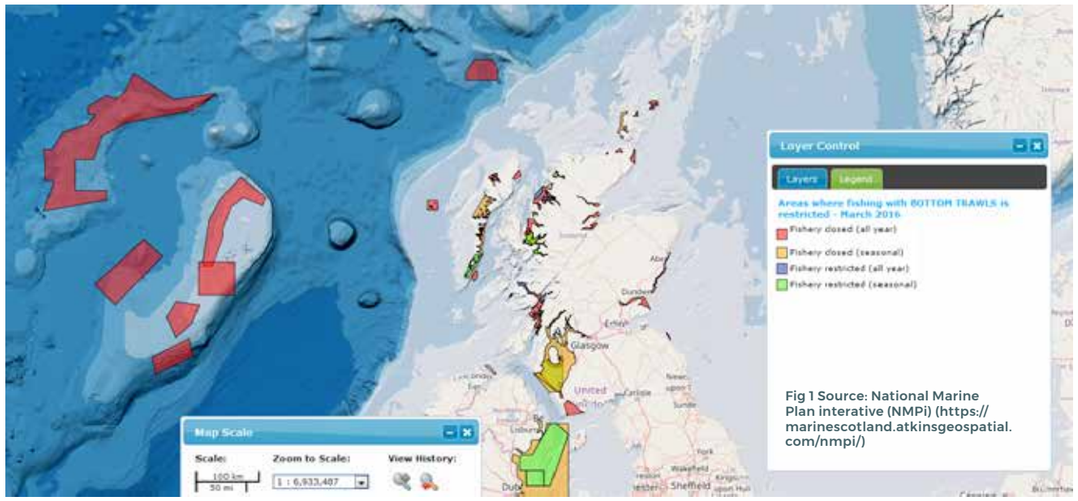


Fig 1 Source: National Marine Plan interative (NMPi) (https://marinescotland.atkinsgeospatial.com/nmpi/)

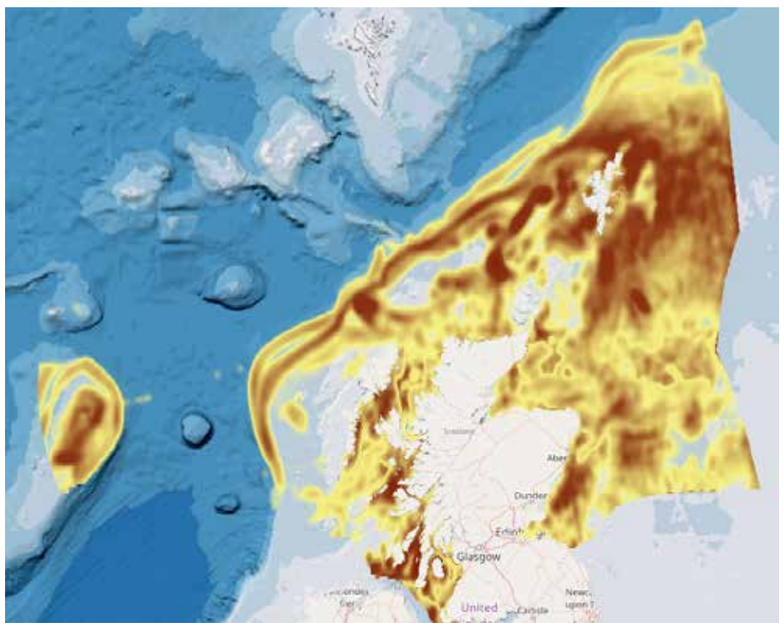


Figure 2. Demersal mobile, *Nephrops* trawl and scallop dredge 2009-2013 amalgamated VMS (vessels > 15 m) intensity layer. Darker colour indicates higher fishing intensity.

Fig 2 Source: ScotMap (https://www.gov.scot/Topics/marine/science/MSInteractive/Themes/ScotMap)

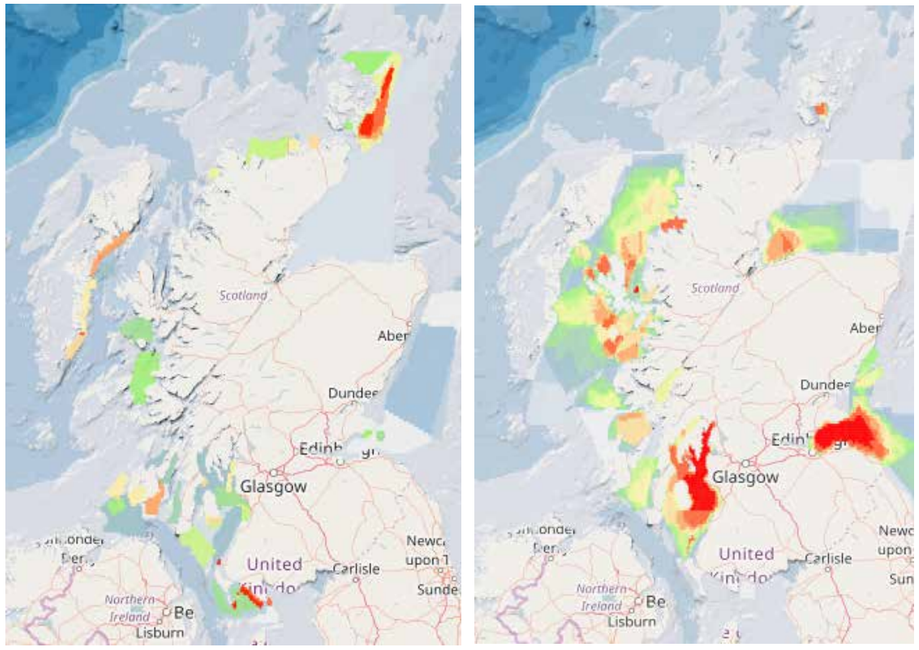


Figure 3. ScotMap (vessels <15m length) monetary value for A) scallop towed dredges, and B) Nephrops trawlers. Red indicates highest value.

Fig 3 Source: ScotMap (https://www.gov.scot/Topics/marine/science/MSInteractive/Themes/ScotMap)

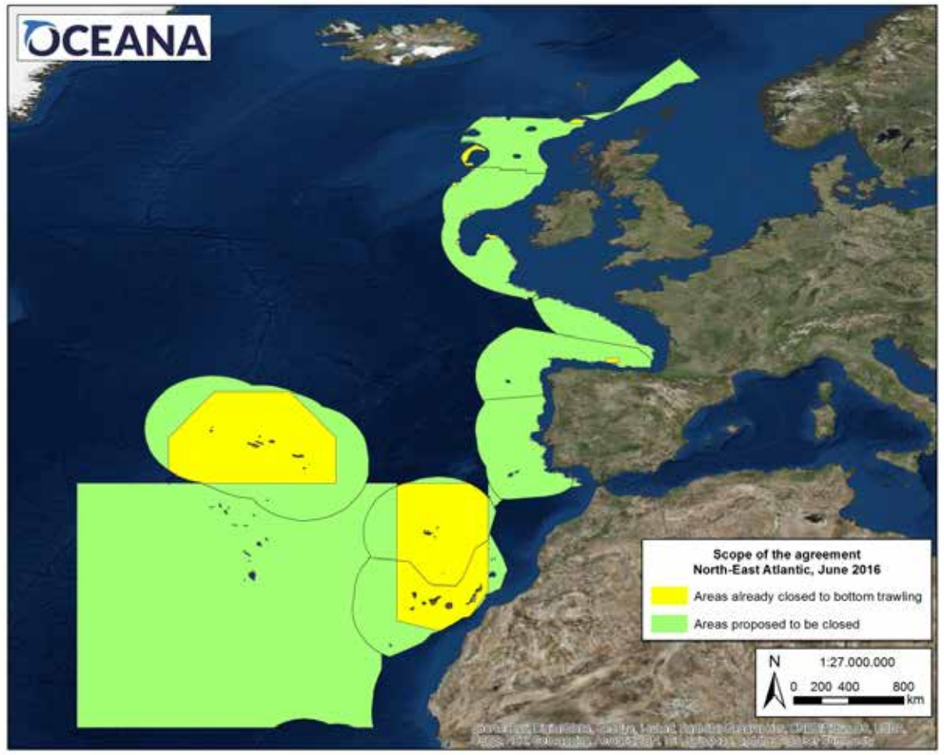
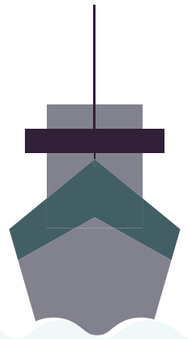


Figure 4. Extent of new restrictions on bottom trawling under the new EU deep sea deal.

Fig 4 Source: Oceana (https://eu.oceana.org/en/press-center/press-releases/oceana-celebrates-deep-sea-trawling-ban-covering-49-million-km2)

Are the present measures sufficient to meet our current obligations under MSFD?



At present the indicators and expected levels for D6 have not been determined, so even if data were available it would not be possible to assess whether GES has been achieved.

The required proportion of spatial measures depends on biological processes, i.e. in their role as a source of larvae to support the resilience of surrounding areas, and on aggregation rule decisions about what proportion of the seafloor must be in sustainable use. Neither of these is known at this time. The recent ICES Working Group found the current criteria and indicators to be inadequate for assessing GES for D6 and have proposed revising the current D6 criteria (ICES 2014b). We attempt to summarise the current thinking on indicators below.

The ICES (2014a) report concluded that the D6 criteria are insufficient and risk compromising the ability to assess seafloor integrity. Since state information is limited, pressure indicators have been suggested as a proxy for determining GES for D6. Indicators have been developed based on the distribution of fishing activities using VMS data (available through Council Regulation (EC) 199/2008). However, little data exists regarding the cumulative impacts of fishing activities, or the synergistic effects of fishing and other pressures.

It is therefore difficult to consider the status of the seafloor beyond the presence or absence of fishing and ecological functioning is also not taken into account unless biological data is also collected (Le Quesne et al. 2010). As noted above, fishing pressure data can at present only provide an indication of state and not of whether the present level of use is sustainable. Acceptable levels of impact are dependent upon the sensitivity and resilience of the different benthic habitats therefore unified reference levels cannot be applied across all habitat types. At present the only practicable measure of pressure is of the extent of areas which are not impacted by mobile gear at all, and the only feasible target for improvement is to maintain or increase this area (ICES 2014a).

Reviews of recovery of habitats and benthic species from trawling and dredging activity have demonstrated the difficulty in predicting recovery potential and trajectories. Recovery time of benthic habitats to impacts of mobile bottom gears is variable depending upon habitat sensitivity and gear type (see (Ryan and Bailey 2012)). Faster recovery rates have been demonstrated in disturbed sandy habitats compared to muddy habitats.

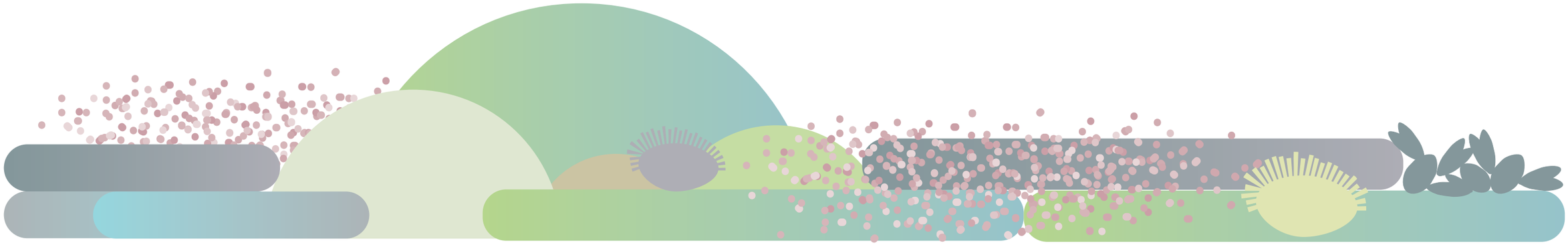
A business as usual scenario was presented in the UK initial assessment report (Defra 2012) that found the status of seabed habitats would be expected to remain stable or improve slightly between 2012 and 2020 depending upon the area concerned. Demersal fishing activity was predicted to decrease in spatial extent between 2010 and 2020 (and beyond to 2030), resulting in an expectation of overall improvement to benthic habitats. This is dependent upon the recovery rates of benthic habitats and the spatial extent of new conservation measures that exclude demersal fishing activity. However, the report also states that the area of benthic habitats likely to be impacted by fishing remains significant, particularly for certain habitat types. Additionally impacts are expected from tidal energy devices, sea-level rise and ocean acidification (specifically on biogenic habitats) and that further management measures may be required (Defra 2012).

At present the only practicable measure of pressure is of the extent of areas which are not impacted by mobile gear at all, and the only feasible target for improvement is to maintain or increase this area.

A pressure indicator is related to policy decisions that can be made (i.e. the level of management for the pressures), whereas state indicators monitor the environmental response as a consequence of the measures taken on pressure level (Berg et al. 2015). Berg et al. (2015) recommend using pressure indicators to define threshold values for pressures (a societal decision) and monitoring the effects using state indicators over a longer time frame.

Using pressure as a proxy for state has limitations. In practice state indicators are not directly related to pressure and typically respond to multiple pressures simultaneously (Smith et al. 2014, Berg et al. 2015). Complex interactions within the ecosystem are not considered if a state change is tightly linked to an individual pressure, hence the reasoning behind an ecosystem-based approach.

However, even when the link between increasing pressure and an ecosystem response is clear and well defined, the recovery response under decreasing or removal of pressure may not follow the same pattern (Tett et al. 2013, Berg et al. 2015). Therefore it is critical to understanding whether GES is achieved that pressure-state relationships are understood. Given this complexity, **Berg et al (2015) suggest that if we are to reach or maintain a specified environmental status, following a precautionary principle for pressures will relieve the burden of understanding which pressure causes a certain state change.**



It is likely to be easier and cheaper to determine GES on the basis of 'absence of pressure' in a region rather than 'presence of good environment'.

Additionally, Borja et al. (2013) suggest that it is likely to be **easier and cheaper to determine GES on the basis of 'absence of pressure' in a region rather than 'presence of good environment'** owing to the difficulty in determining the quality of any ecological element in relation to single or cumulative pressures and accounting for the inherent variability within the system.

Berg et al. (2015) recommend that D6 should either be redefined as a pressure descriptor only, with all state-related aspects of sea floor incorporated into D1, or as a state descriptor that includes functional aspects. Indicators related to ecosystem functioning also need to be included (Berg et al. 2015). This is because **of potential problems with having descriptors comprised of both pressure and state indicators being merged at a criteria level.** The outcome of which being difficult to interpret and the societal response potentially being inappropriate.

The most visible policy response to the MSFD has been the establishment of new UK MPAs through varying pieces of legislation (Hopkins et al. 2016). In Scotland these new spatial measures are called "Nature Conservation MPAs" (hereafter, NCMPAs) introduced through the Marine (Scotland) Act 2010 (within 12 nautical miles) and the Marine and Coastal Access Act 2009 (beyond 12 nm), and together with spatial measures resulting from previous legislation will form part of the "MPA Network". MSFD requires MPAs in a network, as do our previous commitments to OSPAR, CBD and the Habitats Directive. While the MSFD is not feature-led, all these other mechanisms are, leading to the **continuation of a "feature" based designation mechanism for the whole Scottish network. This approach has the potential to lead to a focus on "site condition" and the localised status of individual taxa rather than the wider seas and ecosystem-level criteria required to meet GES**. The designations of NCMPAs refer to the condition of protected features and management measures to "conserve" or "recover" them, without any specific definitions of what these terms mean for each "feature".

There are no quantitative targets for "seafloor integrity" associated with individual MPAs and no baseline quantification of most aspects of this Descriptor for most MPAs. Based on the interpretation that for GES to be demonstrated recovery should occur when pressure is removed it is unclear how "conserve" can be a relevant ambition, unless the system was demonstrably in a "natural" state already.

If an MPA is designated for an area which was previously subject to human pressure it would be expected to change in state if pressures are removed or reduced. For MSFD purposes the measured metrics should change towards a predicted reference state. If they do not then either the MPA would need to already be at reference state, or this would demonstrate that its previous use (and the ongoing use of surrounding areas) were not at a sustainable level. The change in state of relatively small areas of MPAs is most significant for what it says about the level of use of the wider seas.

Rapid positive changes within MPAs would be good news for the mobile fishing industry as they would indicate that the prior and ongoing use was sustainable. Such a finding would not mean that the MPAs were not required however. The ability of the MPAs to recover will be dependent in part on recruitment from other areas, including other MPAs and removing some or all of these, or downgrading their level of management, could reduce the ability of other areas to recover. In fact, **many of the current NC MPAs cannot be expected to change dwramatically as they were specifically chosen by prioritising the "Least Damaged Most Natural" areas**. Often areas will experience only minor changes in use after designation. **This is why D&R MPAs will be so important; because they can be placed in areas typical of fishing grounds, providing a true test.** Protecting residual areas which were not previously heavily fished will of course make little difference to the wider state of the marine environment.

Whereas no reference limits have been set or proposed for the "proportion of area not trawled" pressure indicator, limits have been set for protected area coverage of rare and threatened habitats. However, it is important to reiterate that rare and threatened benthic habitats are listed under OSPAR, and the aims of GES D6 is concerned with benthic ecosystem processes as a whole. Therefore, this leads to a focus on the state of widespread and dominant benthic habitats and thus limits for the protection of habitats of conservation are not immediately applicable (ICES management report, 2010). Concern for rare and threatened habitats falls under GES D1.

Currently, management measures have only been detailed in 14 of the inshore NCMPAs and the effectiveness of these measures will be dependent on compliance and monitoring effort. It is therefore difficult to assess whether the management measures are going to be adequate enough to ensure GES. If the new EU deep sea regulation is implemented this would be expected to have a large and beneficial effect.

Many of the current NC MPAs cannot be expected to change dramatically as they were specifically chosen by prioritising the "Least Damaged Most Natural" areas.

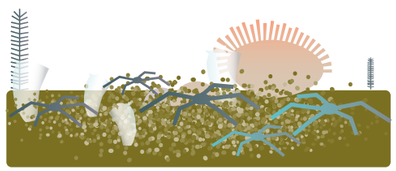
The design of effective, coherent networks of MPAs requires an understanding of how communities are connected and dispersal information for communities. For benthic soft sediment habitats empirical measurements of dispersal for benthic species communities is limited. A key to assessing whether overall GES has been achieved for D6 is if habitat/environmental heterogeneity is maintained allowing representative benthic species to maintain viable populations. Regional scale connectivity should allow dispersal of species and different life-stages between habitats. This connectivity should support recovery dynamics (source-sink) when faced with natural and anthropogenic disturbances (i.e. maintaining integrity) (ICES 2014b).

The ICES Workshop Report (2014) also found that there were no significant points of disagreement regarding what constitutes degradation gradients for environmental status, but found serious uncertainties regarding benthic dispersal scales and tolerances of benthic ecosystems to perturbations. This constitutes a big challenge for assessing GES which requires integration of information from local scales (which may be highly patchy in terms of natural benthic ecosystems and pressures) into regional scales (ICES 2014b).

Lessons learnt and Recommendations for the assessment or achievement of Seafloor Integrity targets

VMS data can be used to report against GES descriptor 6, and also as a pressure indicator of the impact of fishing on rare and threatened habitats for GES descriptor 1.

However, as rare and threatened habitats tend to occupy limited areas, the spatial resolution of the point summation method is potentially inappropriate to examine the impact of mobile bottom gears on these habitats (ICES management report, 2010). VMS data is currently limited in scope, several biases exist including that only larger vessels are included and that there is a limitation on the resolution of the data in comparison to the "patch size" of some habitat types across a heterogeneous landscape to give an accurate picture of seabed quality. Overall there is a limited picture of fishing effort which when combined with limited high quality habitat maps makes assessing seafloor integrity extremely difficult.



In particular how the concept of sustainable use should be included in assessments, that "nearness to natural" does not imply GES and the problematic nature of pressure indicators for the assessment of GES.

MEASURES

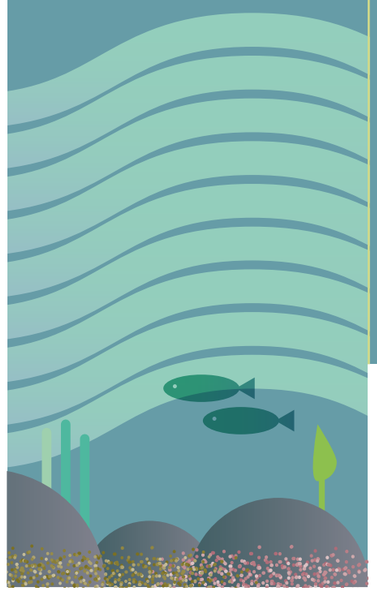
The SNH response to the consultation on the MSFD (SNH 2015) reported that there was currently an over-reliance on the MPA network in the programme of measures to achieve GES at the regional scale of the MSFD particularly in relation to benthic habitats. Further measures could be used under different legislative tools, voluntary codes or strategic planning processes to contribute towards maintenance or achievement of GES. These include cumulative impact assessment in planning, and fisheries and marine users spatial and effort based management, yet these concepts would need to be clarified in the context of marine planning delivering MSFD requirements (SNH 2015).

Specifically concerning benthic habitats, the SNH response stated that the identified measures will make an important contribution to GES, but they will not be sufficient to achieve GES for the habitat condition and physical damage criteria (SNH 2015). More measures are likely to be appropriate outside designated sites, especially on predominant sediment habitats subject to widespread and intense fishing pressure (SNH 2015). For undesignated ('predominant') sediment habitats, there are only trend-based targets and in the absence of a defined target it may be that current measures may help to reduce pressure in these heavily impacted habitats, but may not be sufficient in terms of achieving GES (SNH 2015).

In the process of this work we have considered a number of important concepts which we hope will be useful in considering D6 in Scotland but will be relevant across the EU. In particular how the concept of sustainable use should be included in assessments, that "nearness to natural" does not imply GES and the problematic nature of pressure indicators for the assessment of GES. It is also clear that societal judgement on how quickly change should occur, and how different indicators are aggregated will have at least as great a bearing on the end result as any scientific work. These points are relevant beyond Scotland. Below are some other points arising from the work, specifically on MPAs.

In the absence of baselines how do we know whether the MPAs are in a "good condition"?

The question of whether the MPAs contribute to GES for this descriptor is more complex as unlike fish, some of the factors, which demonstrate seafloor integrity will not "spill-over" (e.g. the physical state of sediments and complex structures). Exceptions may be the larvae of species that are sensitive to mobile gear. The MPAs may represent a reservoir of these taxa, which would be able to help with the "rapid" recovery of areas outside the MPAs if pressures were reduced there in future. In this way the MPAs may be able to help achieve wider seas GES by providing the potential for recovery, even if they do not have any immediate apparent effect on areas outside the network.



How do MPAs contribute to seafloor integrity outside MPA boundaries in the wider seas?

One of the most tangible ways in which MPAs could affect the achievement or demonstration of GES is through their potential as a test. If areas of seafloor rapidly recover to predicted baseline conditions once pressures are removed or reduced then this would constitute evidence that the prior use of the area had been at a sustainable level. If MPAs were representative of wider areas of seafloor then findings of recovery could indicate wider sea GES. However, most MPAs are selected to be "special" in some way and it will often be difficult to extrapolate from them. Fortunately in Scotland a specific mechanism exists which could address this problem, the Demonstration and Research MPA.

Well-designed D&R MPAs would allow temporary reduction or removal of pressures from representative areas of seafloor, providing the opportunity to test for their ability to recover. It would be in the fishing industry's interests to ensure that these plots remained undamaged during the test period. Failure of the plots to rapidly recover would indicate that the system was being used unsustainably and would require additional measures (e.g. larger areas of permanent NC MPAs) to promote the recoverability of the fished areas. In an ideal design the plots taken out of fishing would be compared to control plots within the remaining fished areas. This would allow the effects of environmental change to be separated from the effects of fishing pressure or its removal. In terms of assessing the effectiveness of MPAs for conserving seabed habitats, a monitoring programme should be designed to ensure it can answer three key questions: what is the current state? What is the cause of change? What is the effect of interventions? (Parry et al. 2012).

Parry et al. (2012) recommends that the monitoring programme should ensure: a) representative coverage of the range of features found in the MPA; b) replication of each seabed habitat present relative to the size of the feature; and c) adequate coverage of other potential sources of seabed variation within the MPA such as depth. The survey design should have fixed sampling locations where all parameters are monitored as an integrated monitoring programme rather than monitoring different parameters at different locations (Parry et al. 2012).

MPAS AS A MECHANISM TO ACHIEVE GES

MPAs will contribute to GES if they improve seafloor integrity at "patch" level and provide a source of larvae etc. to improve wider areas and increase their resilience to pressures. Protection of areas which were previously not fished does not contribute to GES, even if it meets a legal requirement to designate them.

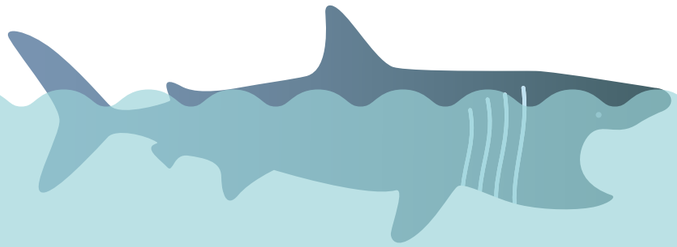
Conclusions

The majority of the questions asked in the tender documents can only be partially answered because we do not yet know what indicators will be chosen for D6, what the target levels will be or how the different criteria and indicators will be aggregated together.

Between these factors it is impossible to say whether current levels of exploitation or extent of spatial management are consistent with GES. The implication of many of the questions is that we currently do not have GES and need to change things to achieve this. This is not necessarily the case and until appropriate assessments have taken place it is premature to suggest additional measures.

What is very likely is that much of Scotland's seafloor is currently modified from a natural state, but what the relevant natural state for each area of seafloor would be is not known. An extensive review for the JNCC by Hill et al (2012) describes the difficulties involved in setting such reference states. On top of this is the fact that the seafloor does not need to be at, or close to, its relevant reference state to be consistent with GES. **The critical test is whether there is evidence that the seafloor retains the ability to recover to a natural state and therefore retains its full potential for other uses. This is the relevant definition of sustainable use when applied to the seafloor.**

We provide suggestions for how sustainable use might be assessed for Scotland's seafloor. **This includes the use of existing or cheap-to-collect measures of state, using the NC MPAs or new D&R MPAs as experiments to test whether the seabed can recover.** If there is no evidence of rapid change towards a natural state when pressure is reduced then the seafloor is not being used sustainably and additional measures will be required. Until we see whether the current MPAs are working it will be difficult to comment further on whether we have enough protected area to meet the requirements of MSFD.



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If there is no evidence of rapid change towards a natural state when pressure is reduced then the seafloor is not being used sustainably and additional measures will be required.

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Annex 1: The Role of the Habitats Directive and its requirements in D6

Under both the Birds and Habitats Directives (EC 1979, 1992) a network of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) have been designated, jointly referred to as the Natura 2000 sites.

These sites are intended to protect and ensure the long-term survival of Europe's most valuable and threatened species and habitats listed under the directives. The integration of these policies with the MSFD is required to achieve a comprehensive GES for Descriptors 1, 4 and 6 (biodiversity, food webs and seafloor integrity) (Cavallo et al. 2016) such as shipping and fishing. The European Marine Strategy Framework Directive (MSFD). However, it is necessary to clearly understand how these policies differ and the areas of potential synergy.

The main aim of the MSFD is to achieve and maintain GES. The Birds and Habitats Directives aim to achieve Favourable Conservation Status (FCS) of particular habitats and species (both terrestrial and marine) across Europe. Although the broad aims of GES and FCS are similar, they are not equivalent. GES will refer to all features in an area and to physical measurements and processes; FCS only refers to the conservation elements (species and habitats) for which a site was designated.

The concept of FCS is central to the Habitats Directive:

'Measures taken pursuant to this Directive shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest.'

Article 2. Habitats Directive. Where habitats and species of 'Community interest' are the habitats listed on Annex I and the species listed on Annexes II, IV and V of the Directive.

'Conservation status' for habitats is defined in Article 1(e) as:

Conservation status of natural habitats means the sum of influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2.[The European territory of the Member States to which the Treaty applies.]

The conservation status of natural habitats will be taken as 'favourable' when:

i. its natural range and areas it covers within that range are stable or increasing, and

ii. the species structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and

iii. the conservation status of its typical species is favourable as defined in Article 1(i).

Conservation status for species is defined in Article 1(i) as:

Conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2.

The conservation status of species will be taken as 'favourable' when:

i. population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and

ii. the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and

iii. there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

'Conservation Status' is seen as the result of "influences" which include the present state of the habitat and species (emphasis on populations), together with current environmental and human pressures (both positive and negative), that may influence its long-term survival.

The references to range, to habitat extent, and to species maintaining themselves, in the definitions of favourable conservation status point to the general intention of the Directive, as being that of maintaining the habitats and species at their contemporary levels (Jones 2002). The baseline for which is likely to be the coming into force of the Directive (i.e. 1994), practicably this baseline will relate to the date nearest to that for which satisfactory information is available (note how this differs from the reference condition under MSFD). However, the status of the habitat or species at baseline may not be currently at FCS, because the pressures acting on it will not enable it to be maintained in the long term. If FCS is to be achieved, the status quo would need to be altered. Additionally, a context for baseline information would need to be developed i.e. time series or trend data rather than a reliance on a snapshot data point (Jones 2002).

Natura 2000 sites are intended to make a substantial contribution towards securing favourable conservation status for listed habitats and species. This contribution will vary from feature to feature depending on the proportion of the feature within the site network.

Areas and populations outside the designated sites will also make a contribution towards FCS proportional to the extent of the feature outside with the network (Jones 2002). A site of community importance is defined as one that contributes significantly to maintenance or restoration at an FCS of a listed habitat or species. An SAC is a site of community importance where necessary measures are applied to maintain, or restore a listed species and habitat to FCS for which the site is designated. Therefore it can be argued that conservation status is applied directly at the site level as in practice, the measures required for SACs are specific and rigorous and effectively the measures deliver the desired outcome (Jones 2002).

There are strong links between MSFD and the Birds and Habitats Directives, and therefore likely that the management measures under the Birds and Habitats Directives will play a significant role towards achieving the GES targets for D1, 4 and 6. However, additional measures may be required to achieve GES in relation to species and habitats not covered by the two directives.

This report was written by Dr Charlotte Hopkins and Dr David Bailey of the University of Glasgow and was commissioned by Scottish Environment LINK's Marine Group.

The LINK Marine Group comprises the following organisations:

Hebridean Whale and Dolphin Trust
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RSPB Scotland
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